To an improvement of RVF surveillance : what do we need as early detection tools ?

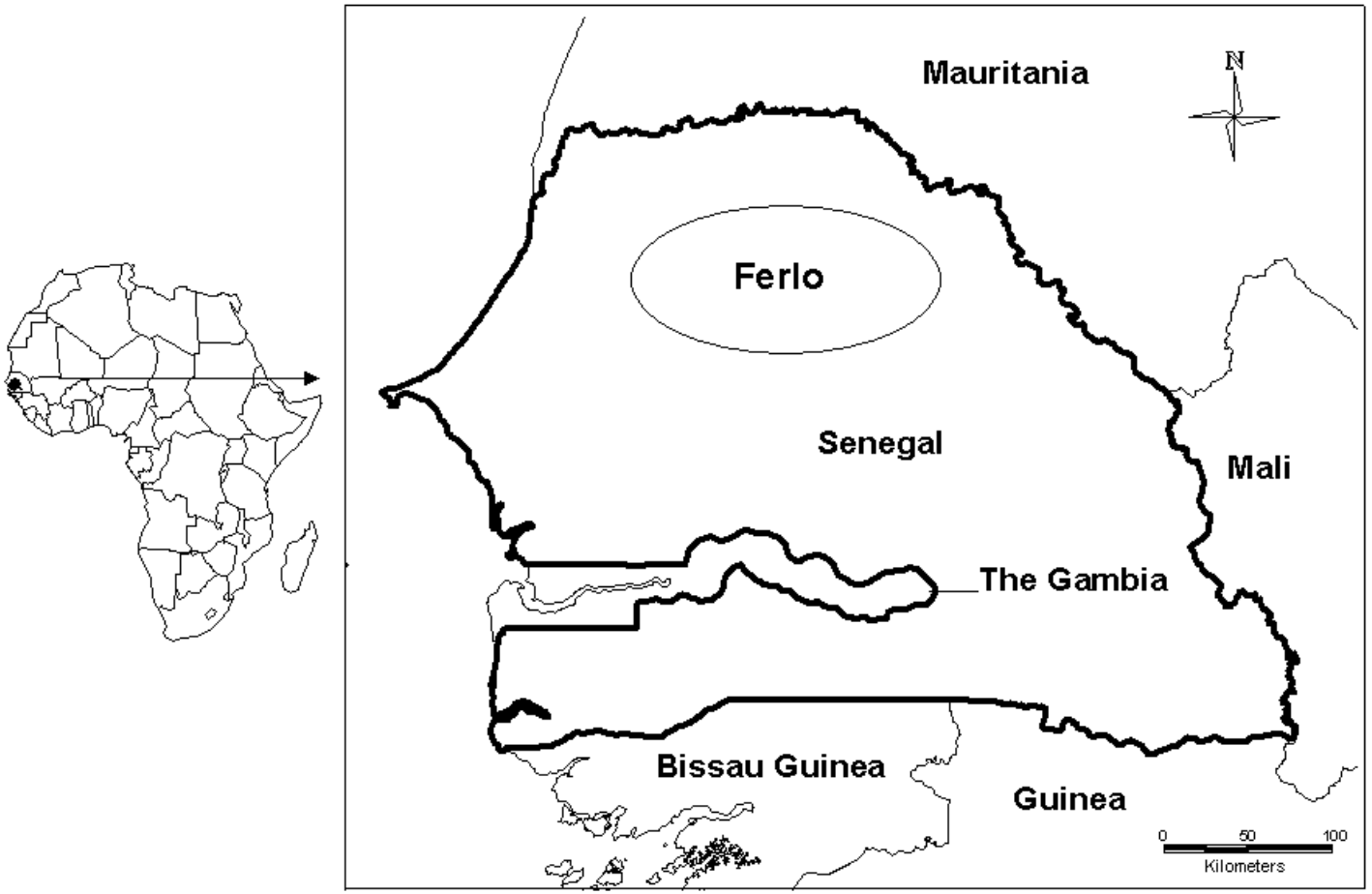
V. Chevalier, F. Roger

UR “Epidemiologie et Ecologie des maladies animales
CIRAD-Emvt

INTRODUCTION

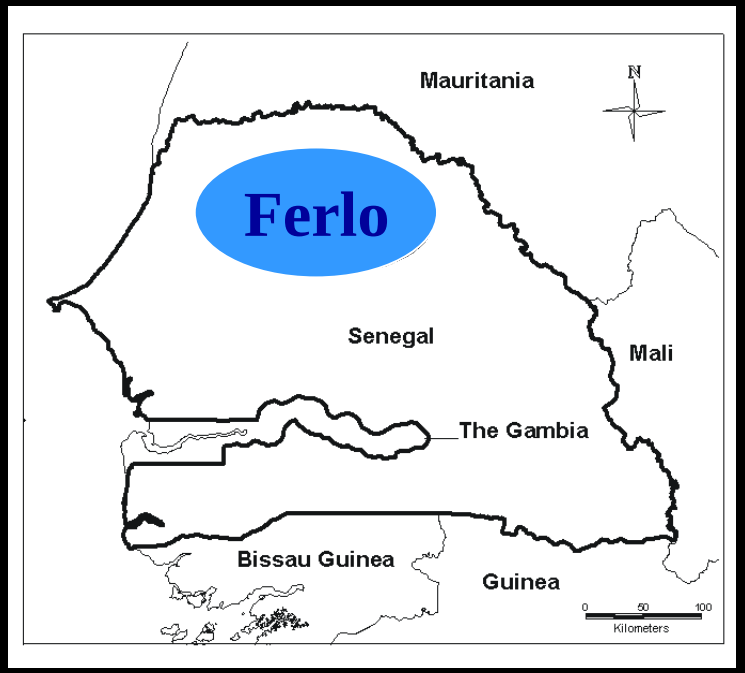
- Rift Valley Fever = emerging arthropod-borne zoonosis
- Hemorragic fever and abortions in small ruminants
- Flu like syndrome in humans but sometimes very severe
- Transmitted from one animal to another by mosquitoes, particularly those belonging to the *Culex* and *Aedes* genera.
- endemic in West Africa
- More recently in the Middle East

- Still expanding despite existing surveillance networks
- Need to understand why the existing networks are not efficient enough
- To improve these networks in terms of data collection, diagnostic tools.


Mauritania
N
Ferlo
Senegal
Mali
The Gambia
Bissau Guinea
Guinea
0
50
100
Kilometers

The Ferlo area

- Sahelian area
- A succession of long dry and short rainy seasons
- A temporary pond system
- Water and grassland attract a massive flood of human populations and livestock



Methodology

- 7 ponds were selected
- 2 sampling sessions: August / mid-December
- Plaque reduction neutralization test
- Abortions reported by farmers
- Rainfall recorded with a rain gauge in Barkedji

Results

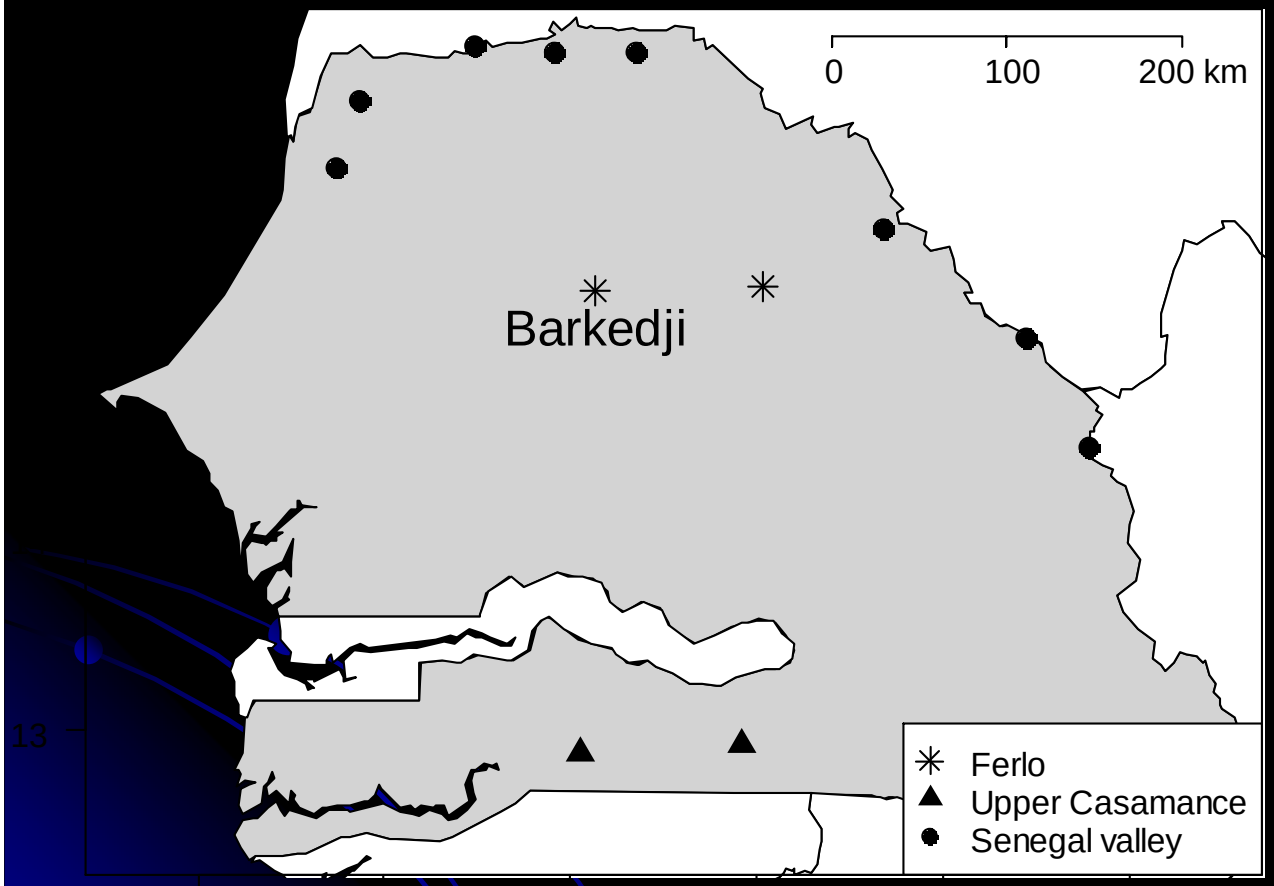
- 1st sampling session:
  - 610 small ruminants
  - Anti-WN antibodies positive dams: 1%
  - Anti-WN antibodies positive offspring : 0%
- 2nd sampling session
  - 379 animals
  - High missing rate (38%)
  - Many abortions recorded (76)
  - Observed incidence rate: 5.4%
  - Large between-pond differences : 0 - 20.3%
  - Annual cumulative rainfall marked a deficit of 5% vs a 30-years average

http://www.cdc.gov/ncidod/EID/vol11no11/05-0193.htm

Discussion (1)

- Intense circulation of the virus in 2003
- Many abortions => probably an outbreak?
- No transmission during the dry season
- Annual cumulative rainfall marked a deficit => Rainfall level: not a relevant predictor for the occurrence of RVF outbreaks in the Ferlo

The RVF Surveillance Network



Since 1987

12 locations

2 or 3 sampling during the rainy season

Seroneutralization

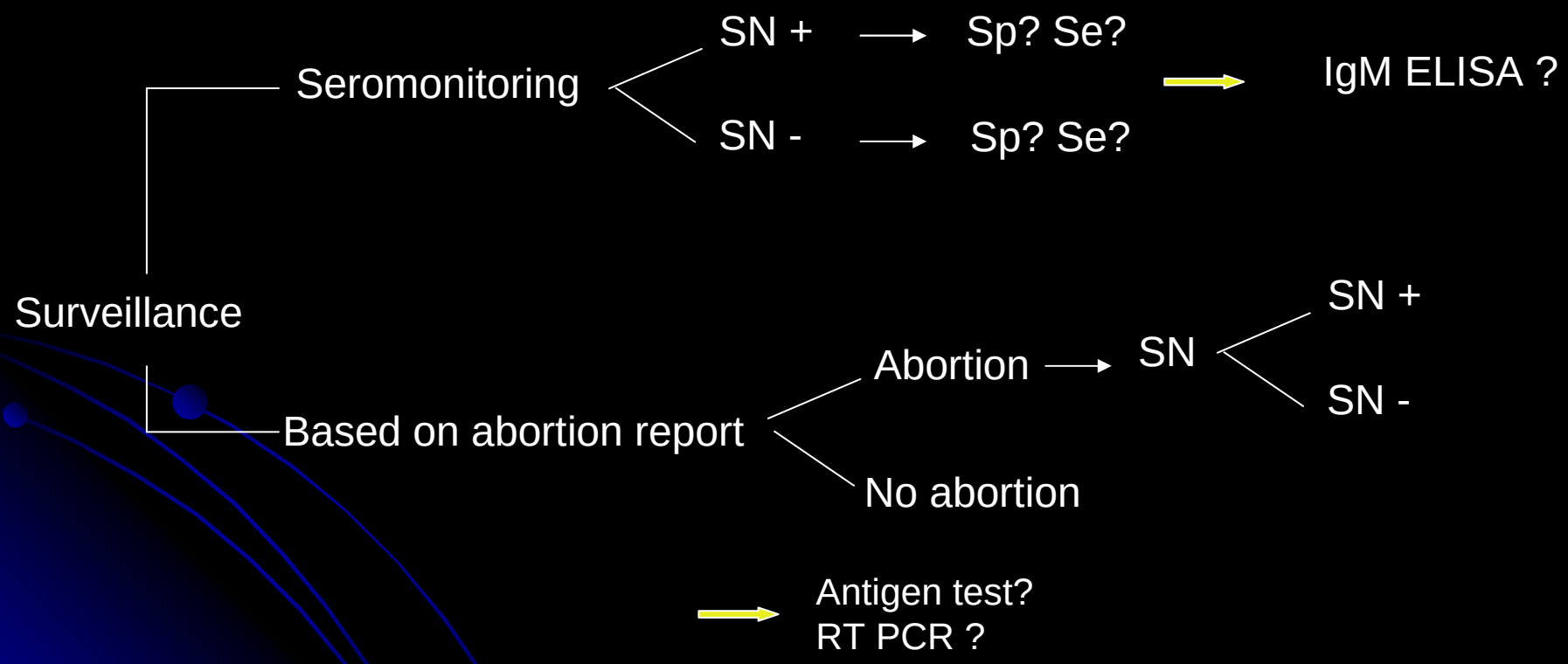
Based on abortion report

Discussion (2)

- In Senegal, 5 outbreaks were recorded in 2003,
- Nothing was notified in the Ferlo
- Outbreak detected at a national level only
- Disease warning issued in November when transhumants farmers had already left the area

  => high risk of dissemination

What do we need in terms of surveillance ?



When abortions occur, the cycle has already been amplified

IgM Seroconversion : best indicator?

What do we need in terms of surveillance ?

- To provide evidence of virus circulation before the outbreak
  - New diagnostic tools
    - Easy use in the field : sampling on filter paper?
    - Quick availability of the results : PCR?
- To be sure of our results
  - To measure the Se/Sp results of diagnostic tests

Efficient diagnostic tests are not enough

- To provide evidence of virus circulation before the outbreak
  - To take epidemiological studies and risk factor identification into account to define hot points,, where a more stringent surveillance would be implemented => **targeted surveillance**
  - Training of veterinarian technicians => **quick** reaction and **quality** of samples
  - To increase awareness of breeders
- To be as sensitive as possible
  - To increase the number of sentinel flocks and the number of sampling locations

Evaluation of a surveillance network

- firstly implemented to assess the absence of a disease in a country.
- may be used to assess the efficiency of a surveillance network and focus on « weak » points
- assumption : a surveillance network is a complex system where informations or data may come from several origins and are combined :
  - Lab results
  - Slaughter houses reports
  - Veterinary services reports
  - Livestock movements reports
  - Epidemiological data
  - Rumors

Current approaches

- Statistically valid survey
  - Money and time consuming
  - Based on lab tests
  - Does not take into account human being failures, and uncertainty

- Global and qualitative evaluation by an expert panel
  - Cheaper because of existing data
  - Accurate : diversity of data origins
  - Durable : global analyses
  - More secure

<u>but</u>

Subjectivity of expert

Non reproductible

historical data

« Only » qualitative

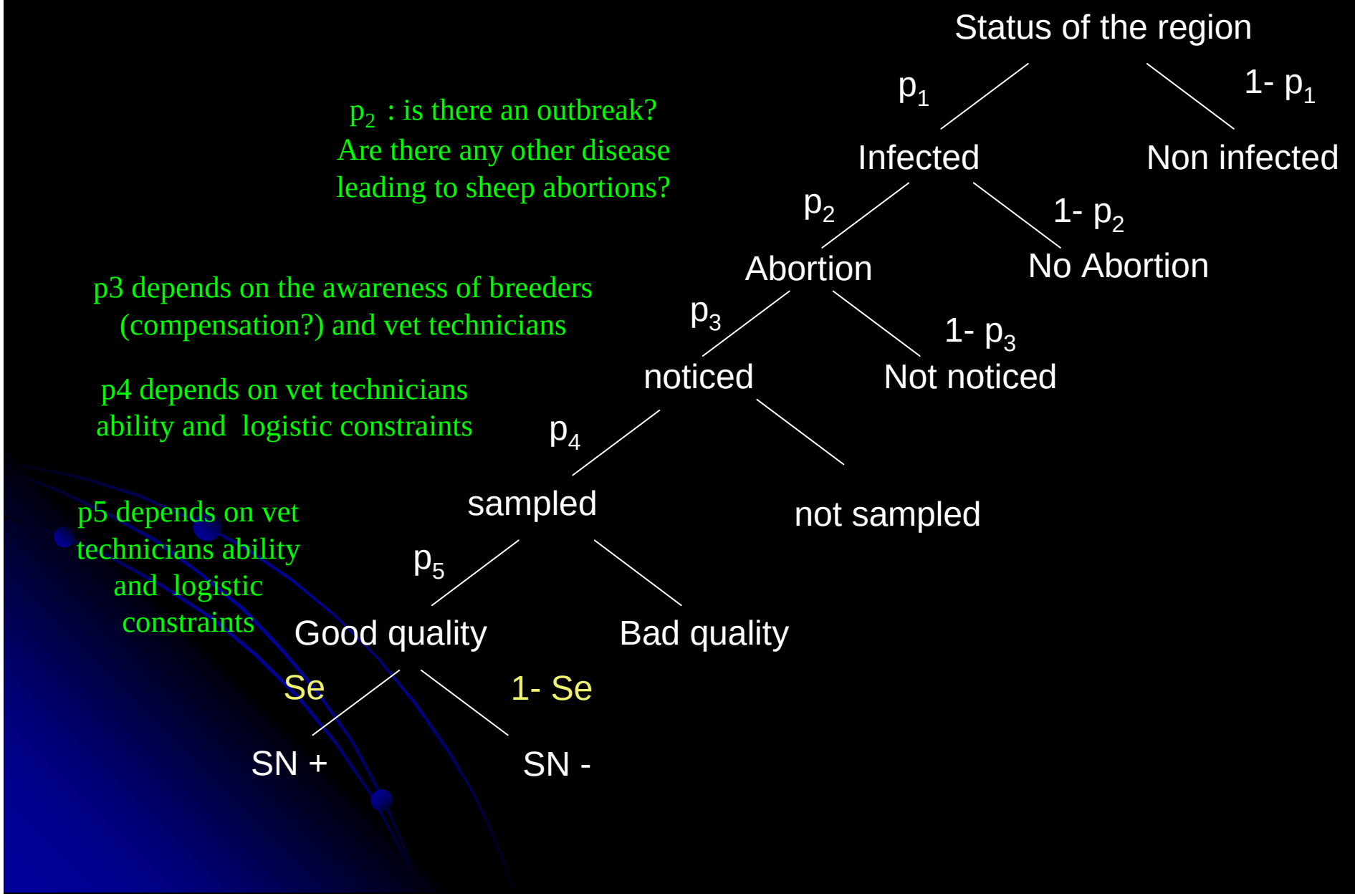
New approach

- A quantitative approach combining the two previous methods
- Based on risk analyses methodology

- To describe all the components of the network
- To calculate or to estimate the sensitivity of these components
- To compare the components between each other
- To perform a sensivity analyses and identify the critical steps of the network

=>To combine the sensitivities of these components and calculate a global sensitivity of the system

Example

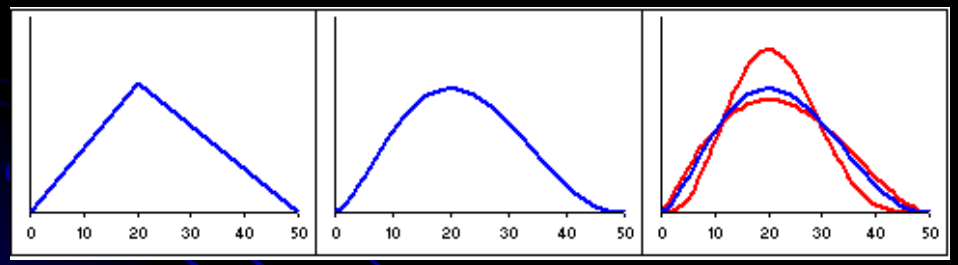

Status of the region
p1
1- p1
Infected
Non infected
p2 : is there an outbreak?
Are there any other disease leading to sheep abortions?
p2
1- p2
Abortion
No Abortion
p3 depends on the awareness of breeders (compensation?) and vet technicians
p3
1- p3
noticed
Not noticed
p4 depends on vet technicians ability and logistic constraints
p4
sampled
not sampled
p5 depends on vet technicians ability and logistic constraints
p5
Good quality
Bad quality
Se
1- Se
SN +
SN -

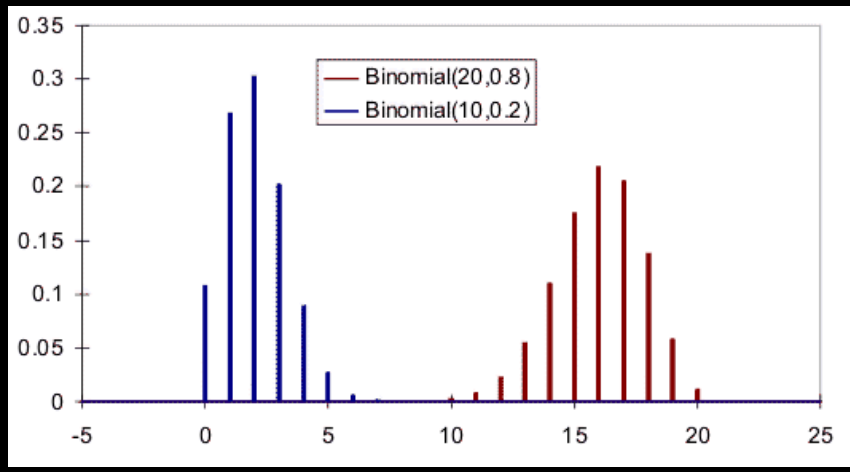
Evaluation of the sensitivity of the network

- The sensitivity of the network is :

$$p_1 * p_2 * p_3 * p_4 * p_5 * Se$$

- But some p can not be calculated



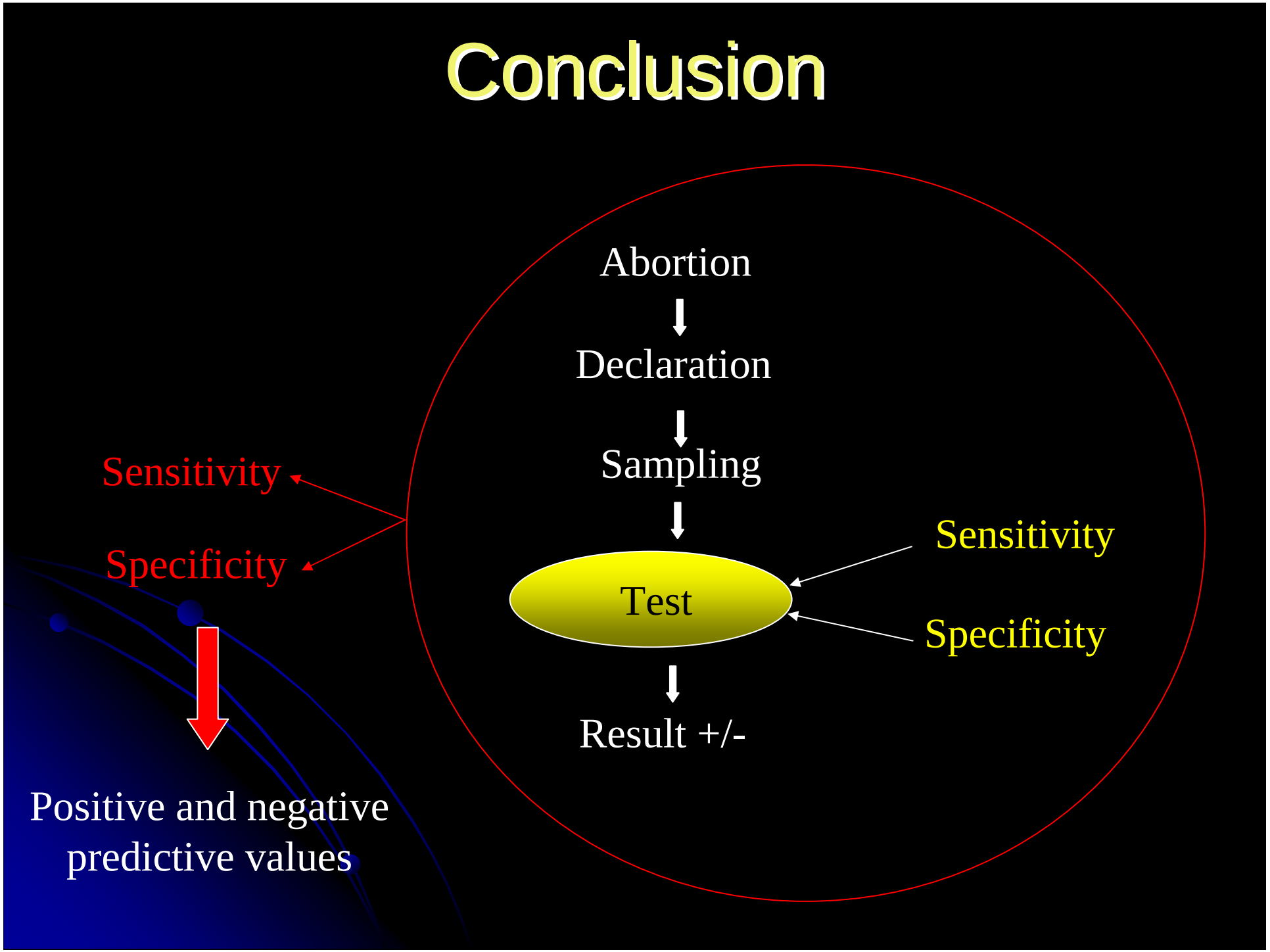


All probability distributions can be combined
=> global distribution of the sensitivity of the network

Example

- Introduction of uncertainty and variability in the decision tree
  - When abortions occur, how many breeders are going to declare them ??
  - What proportions of abortions are declared? Sampled? Arrive in the laboratory?
- Evaluation of the Sensitivity of the network
- Identification of the key points = sensitivity analyses
  - What happens if the number of vet technicians increases ?
  - What happens if the sensitivity of the test is increased ?
  - Is technicians training efficient?
  - Which measure is the most efficient?
  - And what about the cost?

Conclusion


Abortion
Declaration
Sampling
Test
Result +/-
Sensitivity
Specificity
Sensitivity
Specificity
Positive and negative predictive values